Northeast Region

Inventory and Monitoring Program

Product Specifications

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Draft

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Introduction

The National Park Service (NPS) Inventory and Monitoring (I&M) Program has developed a set of specifications for the products that cooperators and contractors deliver to NPS. Well-defined product specifications are necessary to provide cooperators and contractors with a concise list of deliverables representing their work. These deliverables are required at the completion of each biological inventory and monitoring project.

> Please note that these product specifications will continue to evolve, as new data management programs, tools, and methods enable products to evolve. Note also that all non-NPS scientific activities require a permit. See the NPS Research Permit and Reporting System for an online application.

Deliverables

Deliverables are products that result from each I&M project. Cooperators and contractors are required by NPS to provide at least four main types of deliverables:

1. species data
2. metadata
3. voucher specimens
4. progress and final reports

1. Species Data

a) Raw Data

Copies of all raw data (e.g., hand written field forms) must be submitted to the Eastern Rivers and Mountains Network Data Manager.

b) Species Inventory Database

Cooperators and contractors must provide all inventory and monitoring data in an MS Access relational database that uses the I&M Program's Natural Resource Database Template. Database templates have been developed for some Northeast Region inventory projects. Please contact Nathan_Piekielek@nps.gov for information about existing databases and templates.

Each database must include a spatial component, and all cooperators must provide GPS coordinates for all fixed sampling locations (e.g., plots and transects) and any locations where rare, threatened, or endangered species were found in the park. Cooperators are encouraged, but not required, to obtain GPS coordinates for observations obtained from general search areas or opportunistic sightings. Please review the GPS standard operating procedures in Appendix I, Section I of this document. Also, please review the Spatial Data Guidelines in Appendix I, Section II if coverages or shape files are being submitted.

c) Data Dictionary

A data dictionary describes each data field (complete with a definition of the field title), in detail and must be submitted with each database. A data dictionary allows others to understand how the data were collected. See the Data Dictionary example in Appendix I, Section IV.

2. Metadata

"Metadata" means "data about data." Metadata describe *how*, *when*, and *by whom* a particular set of data was collected. Metadata also indicate how the data are *formatted*. Metadata can include information about the quality, condition, and characteristics of a dataset. Metadata usually come in the form of documents, which can be printed, provided on line, and stored in various ways, such as on CDs.

As mandated by the U.S. Federal Governement, all ERMN metadata associated with geospatial data will conform to Federal Geographic Data Committee (FGDC) standards. There are a variety of software tools available for creating and maintaining FGDC compliant metadata. See FGDC Metadata Tools.

The Federal Geographic Data Committee (FGDC) is the committee responsible for creating and maintaining the most widely adopted standard for metadata currently in use in the United States– the FGDC Content Standards for Digital Geospatial Metadata, often called "the FGDC standard". Use the FGDC standard as a style guide for metadata. It specifies the kind of information that belongs in a metadata record and the order in which information should be presented. The FGDC standard provides a common definition for metadata, which everyone can follow. Through use of a common standard, data exchange becomes easier within and among different organizations.

For all NPS Inventory and Monitoring projects, Federal Geographic Data Committee (FGDC) compliant metadata must be provided with all spatial data files. And for all biological data sets (e.g., MS Access and Excel Databases), cooperators must follow the Biological Data Profile of the Content Standard for Digital Geospatial Metadata. FGDC compliant metadata must be parsed using the metadata parser Metadata Parser provided by the USGS. The metadata should be supplied as ASCII text with a .txt extension, as hypertext markup language with an .html extension, or as standard general markup language with an .sgml extension.

All cooperators should contact either the NPS Field Technical Support Center (FTSC) at North Carolina State University, or the ERMN Data Manager if assistance in metadata development is needed.

NPS Field Technical Support Center

Bill Slocumb
North Carolina State University
NCSU Campus Box 7106

Raleigh, NC 27695-7106
Email: bill_slocumb@ncsu.edu
Phone: 919-515-3432

For biological datasets, ERMN has adopted the Biological Data Profile Metadata standards developed by the National Biological Information Infrastructure (NBII). All Network-based datasets will be accompanied by the Biological Data Profile when distributed. Also, all spatial, GPS and imagery data submitted will include metadata that meets the minimum content standard for digital geo-spatial metadata specified by FGDC.

3. Voucher Specimens

The Northeast Region I&M Program has decided to leave issues of vouchering to the discretion of the park where the inventory is taking place. An agreement about the voucher specimens must be reached prior to initiating the inventory. All specimens regardless of their repository will remain the property of the National Park Service and are assumed to be on long-term loan to the housing institution/collection outside of the Service. It is mandatory that cooperators catalog all collected specimens in the Automated National Catalog System (ANCS+), and all specimens must be labeled with the appropriate NPS property label. See Appendix 1, Section III for further guidance on voucher specimen collections.

4. Reports

Progress Reports

Progress reports must be submitted digitally in MS Word format and printed on paper if requested. Minimally, progress reports are due annually, depending on the length and scope of the project. See Guidelines for Submitting Research Proposals and Deliverables for details.

Final Reports

A draft final report must first be submitted electronically in MS Word, and printed on paper if requested, to the Regional I&M Coordinator, the Network Coordinator, and Network Data Manager for management and scientific review and comment. It must include methods, analysis, results, and discussion.

The final report must be submitted both on CD and printed as hard copy. See Guidelines for Submitting Research Proposals and Deliverables for details.
Cooperators are responsible for submitting all other required products with or prior to the final report.

Final Submission of all Deliverables

All deliverables must be submitted on CD to the appropriate Northeast Region I&M Program contacts as well as to all parks involved. All CD's submitted must contain a "Readme" file providing the file name of each file on that CD and a brief description of each of those files. If

possible, all deliverables should be provided on *one* CD, including any PowerPoint presentations created for the project, digital photos taken during the project, recordings of species etc.. All files must be labeled clearly and be referred to in the accompanying "Readme" file.

General Data Formats

Data formats that are acceptable as deliverables include, but are not limited to the following:

- Vector data as ArcGIS 8.x
- Digital imagery (e.g., scanned aerial photographs) as tagged image files (.tiff) files with the proper header file or world file for geo-referencing purposes
- ESRI Arc View Shape File–including .shp, .dbf, and .shx files. ArcGIS .shp files should include the metadata .XML file from ArcCatalog. A projection definition file, .prj, is also recommended.
- ESRI GRID File (for raster data and images that contain attributes other than cell values)
- GeoTiff v1.0 (raster format with geo-referencing stored in the header of the file)
- Tiff with world file **(**tiff files shall be geo-referenced and include the world file .tfw)
- MrSID File (raster file format that may be used natively as an Arc View theme)

See COLO SOP for minimum design standards for attribute tables**:** NPS Nature & Science Management Documents.

For information about other deliverable formats, Please contact Nathan_Piekielek@nps.gov.

Guidelines for Digital Photographic Images

Digital cameras should be set to 600 dpi or to the highest resolution for the camera. In general, digital cameras with less than 5 mega pixels of resolution are not recommended for photos that will be part of any Natural Resources data set. If a 600 dpi setting is not offered on the camera, resolution should be set at 1760 x 1168 pixels or higher. The quality should be set for "super fine" or "high".

Most digital cameras can digitally imprint the date and time onto the photo image. This detracts from the image quality and should not be used. Date and time data are embedded in .jpg and .tiff file headers by most digital cameras. The digital headers (EXIF, IPTC data) should be used whenever possible. Accurate camera date and time is important to maintain since this is often the best link with an image and GPS information. Cameras and GIS equipment should be calibrated frequently.

Large files downloaded from cameras should be compressed to no more than 600 dpi to save space. The 600 dpi files can be copied into lower resolution reference copies. Files that are for use in publications usually require no more than 300 dpi resolution. Most Park Service printers print with a resolution of approximately 165 dpi. Computer screens in use at the Park have only about 96 dpi resolution. Files that do not require significant amounts of resolution, like a vegetation plot photo linked to a database will be much smaller and faster to load if the file size is relatively small. The end use and relative importance of digital image files should be considered before storing and archiving most photos.

The NPS Focus digital library has provided guidelines for image quality and digital camera capacity that may be useful when determining file sizes to store if the high resolution 600 dpi high resolution format is not required. Copies of files may be reformatted to .jpg format to save space and increase loading time when high resolution is not required. See Table 1 for additional information about camera resolution and printed images (Amir Khan, NPSFocus April 2004).

Table 1. Digital camera capability and Effective Resolution

Megapixels	Resolution	Approx. print size (300dpi)	Approx. print size (150dpi)
3 MP	2048x1536	5x7”	10x14”
4 MP	2400x1600	6x8”	12x16”
5 MP	2560x1920	6.5x8.5”	13x17”
6 MP	3000x2000	7x10”	14x20”
8 MP	3264x2448	8x11”	16x22”

APPENDIX I

Section I	***Field Data Collection with Global Positioning Systems***
Section II	***Spatial Data Format***
Section III	***Voucher Specimen Collection***
Section IV	***Database Dictionary***

Section I

Field Data Collection with Global Positioning Systems

Standard Operating Procedures and Guidelines

06/05/02

This section addresses instrument settings, field operation, and data processing for GPS data collection and recommends standards in recording of positional data.

Definition of the Global Positioning System

GPS (Global Positioning System) is currently a constellation of 25 Department of Defense satellites that orbit the earth approximately every 12 hours, emitting signals to Earth at precisely the same time. The position and time information transmitted by these satellites is used by a GPS receiver to determine a location coordinate on the earth using three or more satellites.

The satellites broadcast on two carrier frequencies in the L-band of the electromagnetic spectrum. One is the "L1" or 1575.42MHz and the other is "L2" or 1227.6MHz. Codes are broadcast on these carrier frequencies in much the same way as a radio or television station broadcasts information on its channels (or frequencies). The satellites broadcast two codes–a military-only encrypted Precise Position Service (PPS) code and a civil-access or Standard Position Service (SPS) code.

GPS Receivers

All commercially available consumer GPS receivers are SPS receivers. There are two basic types of SPS receivers: those that use the broadcasted code to do positioning (code-phase), and those that do carrier phase measurements (carrier-phase). PPS or P(Y)-Code (Rockwell PLGR and Trimble Centurion) receivers utilize the P(Y)-code broadcast on the L2 carrier frequency for positioning. This type of receiver is only available to the military and some government agencies.

Positional Data

The National Map Accuracy Standard (NMAS) published by the USGS is the NPS *minimum* standard for map data accuracy. Typically, a GPS will provide much better accuracy then NMAS if it is used carefully and with full attention to the parameters that the user can set or track. To achieve a reasonable and reliable level of accuracy with a GPS, please use the parameter settings described below. Please note that different GPS units use different names for these parameters or define them slightly differently. The discussion below tries to accommodate for these differences. If you have any questions please contact Tim Smith at Tim_Smith@nps.gov or your regional GIS coordinator.

GPS Positional Accuracy

Positional accuracy for autonomous, code-phase, resource grade, or C/A-code receivers range from 100 meters to less than 2 meters. Accuracy for carrier-phase units (often referred to as geodetic receivers) can be measured in millimeters. Accuracy depends on a number of factors. Several factors that can significantly impact data accuracy can be monitored in the field:

- the number of satellite vehicles
- Positional Dilution of Precision (PDOP)
- signal-to-noise (SNR)
- Estimated Horizontal Error (EHE)

One should use at least 4 satellites to attain a 3D position. More satellites will increase accuracy. PDOP relates to satellite geometry at a given time and location. Keep the PDOP as low as possible (ideally, maximum PDOP=4) when collecting mapping data. Some receivers are capable of limiting collection of GPS data if certain GPS quality measures such as PDOP, SNR, and number of satellites are out of range. This is sometimes called "masking". Most receivers (but not all) provide a field estimate of horizontal error (EHE or EPE). With the Rockwell PLGR and Garmin line of receivers, the EHE (or EPE) has been shown to be a very good indicator of overall positional accuracy. In the field, EHE is not presently available on the Trimble GeoExplorer 3.

Positional accuracy for both C/A-Code and carrier-phase types of receivers depends largely on a process called differential correction. In order to achieve greater accuracy, the differential correction procedure is used to limit Selective Availability (controlled by the Department of Defense (DoD) and Ionospheric/Tropospheric degradation of the satellite signals. Although DoD has now set Selective Availability degradation to zero, Ionospheric/Tropospheric degradation can add from 1-7 meters of error to a position. Therefore, differential corrections are required to improve accuracy, maintain positional integrity (confidence), and make a survey tie to a ground-based geodetic survey network.

Differential corrections should be used whenever possible. This removes the greatest source of errors remaining in the GPS error budget. Real-time differential corrections are available through the NDGPS/Coast Guard Beacon System, the WAAS (FAA) satellite based differential system, OmniStar, or a variety of paid private differential services. Post-process differential GPS can be obtained from the NGS base stations available from the web or local community base stations.

Note: To save time and resources, real-time differential corrections should be used whenever possible.

Receiver-Specific Recommended Settings

<u>Garmin and PLGR units:</u>

- *EHE*: less then or equal to 12 meters. This will keep you just within the NMAS for a 1:24,000 map, which is the maximum acceptable.
- *Minimum of 4 satellites (3D)* for every position.
- *Position Type*: If possible and practical, real-time differentially corrected positions should be collected.

Note: Since neither of these units when operating in autonomous mode can mask for GPS quality, it is the user's responsibility to monitor the Satellite page for quality.

Trimble units Pathfinder Systems (PRO XR's, XRS's, and GeoExplorers):

- *PDOP*: less then or equal to 6 (we recommend starting with a PDOP maximum of 4 and shifting to 5 if data collection is not successful at 4; this will keep you around the NMAS for a 1:5,000 map).
- *Minimum of 4 satellites (3D)* for every position.
- *SNR*: less than or equal to 5.
- *Elevation Mask*: 15.
- *Antenna height*: be sure to check for correct antenna height setting. This setting should be the usual height at which the antenna will be carried. If the antenna is attached to a pole, it must be located above the user's head and the antenna height setting should be the height of the top of the pole. Wherever possible, the antenna should be clear of any obstructions.
- *Position Type*: Must be post-processed or real-time differentially corrected.

All GPS units:

- Check the graphics data collection screen regularly to see if you are getting multi-path or other apparent distortions to the data. Garmin and PLGR's require the user to monitor the screen and stop data collection during poor PDOP or SNR windows. Trimble receiver's set to the appropriate mask will stop collecting automatically.
- Be aware of the possibility of multi-path interference and use offsets or other methods to keep the antenna away from building overhangs, tall fences or walls, and heavy canopy wherever possible.
- ALWAYS do differential corrections, either real-time or post processed.
- Feature settings:

Point:

- *Trimble*: minimum of 30 positions, collected at 1 second interval and averaged.
- *All Others*: 90 to 120 positions, collected at 1-2 second interval and averaged.

Line/Polygon:

- use a 2-5 second interval for walking and for road driving, depending on the road type and speed of the vehicle, force (i.e. wait for) a position at each corner, and use a minimum of 3 positions to define any curve/change in direction.

Note: If maximum accuracy is required, sync the collection rate with the base station logging rate. Stations log anywhere from 1 to 30 second data. It is recommended that logging rates be in multiples of 1 or 5 for best differential corrections. Setting logging rates other than 1 and 5 may reduce the number of positions that are in sync with base data and reduce accuracy. Try to map all features in a single area in a single day or on consecutive days.

Attribute Data

Data dictionaries (e.g., Trimble) or data collection forms (e.g., ArcPAD) are designed to describe features (landscape, biological, cultural, or historical) simply, efficiently, and without redundancy. A data dictionary or form organizes data into types or themes and reduces user error when entering values. This type of data collection is an efficient use of time and energy. Set up a menu and pick-lists in a database and load them into the GPS unit or data collection device prior to going out into the field. Create and use a data dictionary or data collection form whenever possible to collected attribute data.

Coordinate Metadata

Record the following:

1. EHE/EPE or maximum PDOP (using 4 satellites)
2. Coordinate datum
3. Coordinate projection
4. Projection Zone, if using UTMs or State Plane

The following parameters should be used in selection of datum and projection.

Projection and Coordinate System

All digital geospatial data should reference the appropriate coordinate system, and this reference should be noted in the metadata. All spatial data collected or submitted for national, regional, or network NPS programs shall be geo-referenced and provided in a standard projection. Digital geospatial data should be referenced to two coordinate systems–the current standard system used by the individual park (generally UTM, NAD83) and a regional-scale system (Geographic, NAD83). The steps used to get the data into the proper projection must be documented in the metadata. The project manager must specify, approve, and document any deviation from these projection standards.

NPS-wide and Regional Data Standard

The standard projection for most NPS regions and national programs is geographic with the following parameters as per Executive Order 12906 and the Federal Geographic Data Committee (FGDC) standards:

Datum North American Datum 1983
Spheroid GRS 1980
Units Decimal Degrees

Park Unit Data Standard

The standard projection for most NPS regions and national programs is Universal Transverse Mercator (UTM) with the following parameters:

Projection Universal Transverse Mercator
Datum North American Datum 1983
Spheroid GRS 1980
False Easting 500,000
False Northing 0
Units Meters

Unit Standards for Exceptions

In addition to the systems noted above, several NPS units require additional specific standards for data delivery (e.g., Cabrillo and Craters of the Moon National Monuments). Parks in Hawaii and other Pacific islands will be in the datum and projection specified by each park. Because of its geographic location, the NPS Alaska Region also requires a specific datum and projection as noted below. However, data sets for use regionally and system-wide should be provided in latitude/longitude (decimal degrees) and NAD-83.

Alaska Region

The standard projection for Alaska Region parks uses the following parameters:

Projection Alaska Albers Equal Area
Datum North American Datum 1927
Spheroid Clark 1866
False Easting 0
False Northing 0
Central Meridian -154 00 00
1st Standard Parallel 55 00 00
2nd Standard Parallel 65 00 00
Units Meters

Horizontal / Vertical Accuracy and Precision

All spatial data collected shall be analyzed for their spatial accuracy and shall meet or exceed the National Mapping Program Standards for the particular scale intended. Longitude and Latitude coordinates for geographic data should be recorded to a minimum of 5 significant digits to the right of the decimal point and stored in double precision attribute or database fields. Any calculations done with location data should be done at double precision with the results rounded or truncated to the appropriate propagated error limits. All calculations and processes completed on the spatial data shall be reported in the metadata.

Additional Data Collection Notes

- Positional coordinate data should not be recorded in NAD-27 in the field. Datum conversions should be done as an office, post-process activity using software that utilizes a full NADCON datum conversion in order to assure accuracy and precision.

- When estimating distances, Latitude/Longitude decimal degrees can be used the same as Universal Transverse Mercator coordinates (UTMs). The digit in the fifth decimal place of decimal degrees can be used as approximately a meter.

- Real-time differential techniques should be employed whenever possible for efficiency and time savings.

- The distance between the base station and the remote GPS receiver should be kept to a minimum, preferably less than 150 miles.

Section II

Spatial Data Guidelines

Spatial data, which include GPS generated files, must conform to the following guidelines:

Projection and Coordinate System

All digital geospatial data should reference the coordinate system corresponding to the standard presently in use at the park which, for most parks, will be the correct UTM zone in which the park is found. The datum should be the North American Datum of 1983 (NAD83); the ellipsoid should be the Geodetic Reference System 80 (GRS80); and the units of measure should be meters. The contractor should contact the park's GIS Coordinator for specific instructions and/or refer to the contract or cooperative agreement.

Scale and Spatial Resolution (Vector Data)

New data should not exceed 1:24,000. The contractor should contact the park's GIS Coordinator for specific scale and spatial resolution requirements for vector data or they may be specified in the contract or cooperative agreement.

Scale and Spatial Resolution (Image Data-digital or aerial photography)

The contractor should contact the park's GIS Coordinator for specific scale and spatial resolution requirements for image data, or they can be specified in the contract or cooperative agreement.

For vegetation classification under the NPS/USGS vegetation classification project, the current standard is 1:12,000 color infrared aerial photographs with 60% overlap and 30% sidelap.

Horizontal and Vertical Accuracy

All data should meet or exceed the following National Map Accuracy standards (Source: USGS Fact Sheet 078-96, September 1997). For maps on publication scales larger than 1:20,000, not more than 10 percent of the points tested shall be in error by more than 1/30 inch, measured on the publication scale; for maps on publication scales of 1:20,000 or smaller, 1/50 inch. These limits of accuracy shall apply to positions of well-defined points only. Well-defined points are those that are easily visible or recoverable on the ground, such as the following: monuments or markers, such as benchmarks, property boundary monuments; intersections of roads and railroads; corners of large buildings or structures (or center points of small buildings). In general, what is well-defined will also be determined by what is plottable on the scale of the map within 1/100 inch. Thus, while the intersection of two roads or property lines meeting at right angles would come within a sensible interpretation. Identification of the intersection of such lines meeting at an acute angle would not be practicable within 1/100 inch. Similarly, features that are not identifiable on the ground within close limits should not be considered as test points within

the limits quoted. This is true even if their positions can be scaled closely on the map. This class would cover timber lines and soil boundaries.

Vertical accuracy, as applied to contour maps on all publication scales, shall be such that not more than 10 percent of the elevations tested shall be in error by more than one-half the contour interval. In checking elevations taken from the map, the apparent vertical error may be decreased by assuming a horizontal displacement within the permissible horizontal error for a map of that scale.

The following table provides the allowable horizontal accuracy for some common scales:

Scale	Allowable error (feet)
1:40,000	111
1:24,000	40
1:20,000	33
1:12,000	20
1:9,600	16
1:4,800	8
1:2,400	4
1:1,200	2

Attribute Accuracy

At a minimum, an 80% or greater overall thematic attribute accuracy at the 90% confidence interval is required. The contractor should contact the park's GIS Coordinator for specific attribute accuracy requirements, or these can be specified in the contract or cooperative agreement.

Spatial Data Formats

At a minimum, all vector data should be supplied as an ArcInfo coverage and ArcInfo interchange file, e00, compatible with the current version of ArcInfo for the MS Windows operating system. All raster data is to be supplied as an ArcInfo GRID and ArcInfo interchange file, compatible with the current version of ArcInfo for the MS Windows operating system. All digital imagery, such as scanned aerial photographs, is to be supplied as tagged image file format (.tiff) files with the proper header file for geo-referencing purposes. The contractor should contact the park's GIS Coordinator for specific data formats, or these can be specified in the contract or cooperative agreement. All data should be delivered on CDs compatible with the MS Windows operating system.

Quality Control

When the contractor has completed 10% of the spatial and attribute data development, the contractor must supply the data to the park and appropriate Regional Technical Support Center (RTSC) for quality control purposes. The data must be delivered in conformance to the Spatial

Data Formats requirements. Once the park and RTSC have checked the data and found it acceptable, the contractor may continue data development. Once the contractor has completed the work, the park and RTSC must accept the spatial data, attribute data, and Federal Geographic Data Committee (FGDC) compliant metadata before the job is considered complete.

Results of tests used to verify all applicable horizontal, vertical, and attribute accuracy measurements should also be provided whenever data is provided to the park and RTSC.

Section III

Voucher Specimen Collection

All vertebrate and vascular plant specimens collected in Northeast Temperate Network parks will be housed at Acadia National Park. Repositories for specimens collected in other Networks in the Northeast Region have not yet been determined. At this time, specimens collected in those parks will be housed at the cooperating University or associated institution with the stipulation that under federal law, all specimens are the property of the NPS and are on long-term loan to the receiving institution.

Acquisition of a valid park permit to collect specimens, as well as the preparation of all specimens, is the responsibility of the cooperator. The final decision on the collection of voucher specimens will be left up to the discretion of the park, but the collections policy for the Northeast Region I&M Program is as follows. **Cooperators may collect whole specimen vouchers** of amphibians, snakes, mammals, fish, and plants **only if**:

1. **Identification of a species is in question.** This may mean that certain taxa, such as fish, may require more intensive vouchering than other taxa.

2. **Or if a particular species has not yet been collected in a park**. A list of existing voucher specimens will be available for each park, and cooperators are required to review this list prior to fieldwork.

Plants and animals that **may not** be whole-specimen vouchered include birds, turtles, large mammals (unless found as road kill), and common plant species. If vouchering is necessary for any of these because no voucher exists for a particular park, photo documentation is required.

Cataloging Specimens

Cooperators must catalog all specimens in the Automated National Catalog System (ANCS). Please contact Nathan_Piekielek@nps.gov for information on obtaining the ANCS+ software. In some cases, depending on where the specimens are housed and how many specimens are collected, collection curators will be available to assist cooperators in making the ANCS+ entries.

Vouchering Methods

a) Photo Documentation

The Northeast Region I&M Program is requiring all cooperators to use non-invasive methods of vouchering, such as color photography, or other signs or remains (e.g. hair samples, scat, or tracks) whenever possible. Photographs of a species will be considered a voucher and will be referenced in the NPSpecies database. Photographs taken to provide documentation of a species must be taken with a macro or close-up lens. Photographs should show features used for identification of the species. It may be necessary to take more than one photograph of an individual from different angles. All photographs must be submitted with the pertinent raw data. All slides and photographs must be kept in appropriate protective sleeves. Digital photos must be

provided on CD. Each CD must contain a "Readme" file providing a list of all files and description of each file submitted on that CD.

b) Whole Specimens

Voucher preparation is the responsibility of the cooperator who must have a valid park permit to collect specimens. All vouchers taken on NPS lands, regardless of their repository, will be the property of the NPS. Cooperators will be responsible for accessioning voucher specimens into ANCS+.

Mammalian Collection

To minimize disturbance on mammalian populations in parks, photo vouchering and collecting animals where death resulted from either trap mortality or road kill will be prioritized over euthanizing individuals. Guidelines found in the *Live Animal Capture and Handling Guidelines*, manual no.3, will be followed for proper capture, handling and euthanasia procedures. Guidelines and references for the preservation of voucher specimens can be found in *Measuring and Monitoring Biological Diversity, Standard Methods for Mammals* (Wilson et al, 1996).

Fish Collection

Digital photographs can be an accurate and economical method for vouchering fish specimens. Please follow the guidelines for vouchering fish specimens by Dr. Jay Stauffer and Timothy Stecko from Penn State University. (Please request this document from Nathan Piekielek). Although it may not be possible to identify all fish specimens from digital photographs taken in the field, these guidelines will be useful for most fish collected. Immature fishes of all species and some of the minnow species, particularly in the genus *Notropis*, need to be collected and properly preserved.

Amphibian and Reptile Collection

For identification, most species of amphibians and reptiles can be adequately confirmed from photographs. Collecting whole specimens of amphibians and snakes will only be allowed as stated above, if a whole specimen does not exist for a park. Turtles may only be vouchered through photo documentation.

Vascular Plant Collection

Species that are common to the park or have already been vouchered should not be collected. Because any collection of specimens impacts a population, it is especially important when collecting rare species to weigh the destructiveness of collection against the amount of information gained. Federal and state Threatened and Endangered plants will not be collected in populations of fewer than 50 individuals (Elzinga et al, 1998). It is incumbent upon the cooperator to know which taxa are locally or nationally rare or protected, and to be familiar with all federal and state legal procedures for collecting. In small populations, only small portions of plants will be collected if necessary. Cooperators are advised to collect discriminately, even in large populations, and to collect only the minimum amount of plant material necessary (The Plant Conservation Round Table, 1986).

Voucher specimens will be collected during inventory in accordance with collections policies outlined in *NPS Management Policies* ("Museum Objects and Library Materials" and "Preservation of Data and Collections and Protection of Research Potential") and NPS-77, *Natural Resource Management Guideline*.

Section IV

Data Dictionary Example

A data dictionary is part of a database management system that provides specific descriptions of the data housed in the database. This section demonstrates a basic data dictionary example.

DATA DICTIONARY

Data Field and Attribute Definitions

BIOLOGICAL INVENTORY

Final Report Title: Comprehensive Inventory Program for Birds at Six Pennsylvania National Parks (ALPO, EISE, GETT, HOFU, JOFL, VAFO), 1999-2001
Database Filename: VAFO_Birds_2002.mdb

TABLE INDEX

tblEvents

Field Name	Field Type	Field Width	Field Description
EventID	Text	255	Sampling Event ID such as EISE_BIRDS_SHRIKE_2000-May-15_00:01 where EISE=park code, BIRDS=general survey type, SHRIKE=specific survey type, 2000-May-15=date, 00:01=time where applicable or 00:00 where the last digit(s) are the survey point
Park	Text	50	Park Code. See tluParkName.
GeneralSurveyType	Text	50	Type of Biological Inventory – BIRDS
SpecificSurveyType	Text	50	Type of Bird Survey – OWL, POINTCOUNT, RAPTOR, RIPARIAN, ROAD, SHRIKE
StartDate	Date	8	Date (mm/dd/yy) when sampling began
StartTime	Date	8	Time (hh:mm) when sampling began. Start times were not recorded for Shrike and Road Surveys.
Visit	Long	4	Either the first, second or third visit during a specific season of a particular year.
Season	Text	50	Fall (25 Aug - 10 Oct), Winter (1 Dec - 15 Mar) , Spring (15 Apr - 25 May), Breed (25 May - 15 Jul)

tblLocations

Field Name	Field Type	Field Width	Field Description
LocationID	Text	255	Location ID code such as ALPO_BIRDS_Point Count_1 where ALPO=park code, BIRDS=project, Point Count=specific survey type, 1=survey location unique to specific survey type
ParkCode	Text	50	4-character Park Code. See tluParkName
Project	Text	10	Code for component of program (Weather, Birds, Fish, Veg Plots, etc.)
SurveyType	Text	50	Type of survey conducted at location (Owl, Point Count, Raptor, Riparian Bird, Road)
SurveyLocation	Text	50	Survey location number unique to survey type.
StartUTMX	Double	8	UTM X (easting) coordinate for the center of the plot or location OR starting point of a line or polygon (double precision to15 significant digits)
StartUTMY	Double	8	UTM Y (northing) coordinate for the center of the plot or location OR starting point of a line or polygon (double precision to15 significant digits)

tblBirdEvents

Field Name	Field Type	Field Width	Field Description
EventID	Text	50	Sampling Event ID such as EISE_BIRDS_SHRIKE_2000-May-15_00:01 where EISE=park code, BIRDS=general survey type, SHRIKE=specific survey type, 2000-May-15=date, 00:01=time where applicable or 00:00 where the last digit(s) are the survey point
Temp	Double	8	Temperature in degrees Fahrenheit.
Wind	Double	8	Wind speed in miles per hour.
Clouds	Double	8	Percentage cloud cover.
Precip	Double	8	Indication of precipitation. 0 = none and 1 = light snow during winter or mist to light drizzle during spring, breed, or fall.
SnowDepth	Long	4	Snow depth in centimeters.

tblLocOverstory

Field Name	Field Type	Field Width	Field Description
LocOverstoryID	Long	4	Unique autonumber assigned to each record in the table
LocationID	Text	50	Location ID code such as ALPO_BIRDS_Point Count_1 where ALPO=park code, BIRDS=project, Point Count=specific survey type, 1=survey location unique to specific survey type
Observer	Text	50	Last name(s) of the investigators that conducted the survey.
Species	Text	255	Common or generic name of the overstory tree.
DBH	Double	8	Diameter at breast height in inches of each overstory tree within a 38 foot radius of the point center. Overstory trees were > 5 feet tall and > 2.9 inches diameter at breast height.
Date	Date	8	Date that vegetation sampling occurred.

tblOwlSurvey

Field Name	Field Type	Field Width	Field Description
LocationID	Text	255	Location ID code such as ALPO_BIRDS_Point Count_1 where ALPO=park code, BIRDS=project, Point Count=specific survey type, 1=survey location unique to specific survey type

Field Name	Field Type	Field Width	Field Description
EventID	Text	255	Sampling Event ID such as EISE_BIRDS_SHRIKE_2000-May-15_00:01 where EISE=park code, BIRDS=general survey type, SHRIKE=specific survey type, 2000-May-15=date, 00:01=time where applicable or 00:00 where the last digit(s) are the survey point
Species	Text	255	Four letter species code identifying the common name of a bird. Bird common names and their associated species codes are found in the tluBirdSpecies table. * = none detected.
Individuals	Long	4	Number of individuals detected. 0 = none detected.
Detection	Text	50	Method of detection. V = visual, S = song, C = call, and * = no data collected.

tblPointCountSurvey

Field Name	Field Type	Field Width	Field Description
PointCountSurveyID	Long	4	Unique autonumber assigned to each record in the table
LocationID	Text	255	Location ID code such as ALPO_BIRDS_Point Count_1 where ALPO=park code, BIRDS=project, Point Count=specific survey type, 1=survey location unique to specific survey type
EventID	Text	255	Sampling Event ID such as EISE_BIRDS_SHRIKE_2000-May-15_00:01 where EISE=park code, BIRDS=general survey type, SHRIKE=specific survey type, 2000-May-15=date, 00:01=time where applicable or 00:00 where the last digit(s) are the survey point
Species	Text	50	Four letter species code identifying the common name of a bird. Bird common names and their associated species codes are found in the tluBirdSpecies table. * = none detected.
Individuals	Long	4	Number of individuals detected. A blank space = none detected.
Distance	Long	4	Distance that the bird(s) were from the point center. A blank space = not applicable.
Detection	Text	50	Method of detection. V = visual, S = song, C = call, and * = no data collected.
Interval0-3	Double	8	0-3 indicates the initial three minutes of the point-count survey. 0 = not first detected during this time period and 1 = first detected during this time period. A blank space = no data collected.
Interval3-5	Double	8	3-5 indicates the three to five minute time period of the point-count survey. 0 = not first detected during this time period and 1 = first detected during this time period. A blank space = no data collected.
Interval5-10	Double	8	5-10 indicates the last five minutes of the point-count survey. 0 = not first detected during this time period and 1 = first detected during this time period. A blank space = no data collected.